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The Amount of Dursban Pesticide Residues in Isfahan Sugar Beet

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Abstract

Communities are concerned with the role of durable pesticides and their carry over effect in food chains. Accordingly, the recognition and measurement of chemical compounds in food, environment and living bodies is necessary. In this study, which dated from October 2010 to March 2011, dursban toxin residues in sugar beets were investigated in the cities of Isfahan province including: Isfahan, Borkhar, Semirom, Golpayegan and Fereidan using high performance thin layer chromatography (HPTLC). Maximum amount of dursban belonged to Borkhar region and the minimum amount was attributed to two regions of Isfahan and Golpayegan. The toxin residues in sugar beets in all investigated areas were higher than the maximum allowable residues of any pesticide MRL (0.01 mg in kg sugar).

Keywords: Residual insecticides - Thin layer chromatography HPTLC method- sugar beet – Dursban

1. Introduction

Today food security and safety are important issues for consumers of agricultural products. Farmers around the world are forced to use pesticides to attenuate the loss of agricultural products, while pesticide remains on the surface and even inside of their products (3). Although washing can be effective in

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reducing the contamination level, eliminating toxic pesticides from internal tissues of the fruit is nearly impossible. Therefore, agricultural products high likely contain residual amounts of pesticides (1). Excessive use of pesticides in farms could produce residual toxins that disrupt the natural food chain and subsequently environmental pollution and human health hazards drastically.

Sugar beet is a plant derived from the Spinach family by the scientific name *Beta vulgaris rapa var altissima*. Sugar beet cultivation in Iran has begun since 1884 in villages surrounding Kahrizak with the assistance of Belgian experts. At that year, Kahrizak beet process factory was established closed to Tehran and began to work with a daily capacity of 70 tons of beet sugar (2). Since the beginning of the twentieth century, due to the increasing needs for this food, the areas under sugar beet cultivation have increased rapidly around the world. Sugar derived from beet roots is a substance for human nutrition which is a stimulant which provides energy (100 cal per 25 grams sugar). Beside sugar production, alcohol is also extractable from these factories (3). Sugar beet cultivation is performed mainly in the cities of Isfahan province (Isfahan, Borkhar, Semirom, Golpayegan and Fereidan) with 3,500 hectares in 2010. Most of these sugar beet supplies two sugar factories in Esfahan: Isfahan sugar factory and Naghsh-e-jahan factory.

Following the production of a wide range of pesticides, the third decade of the twentieth century can be called the era of organic synthetic pesticides. Chlorinated organic pesticides were identified and constructed in 1939 and identification of organic phosphorus pesticides took place in 1946 and also the first artificial pyrethroid was made in 1949 (4, 5, 7). Dursban is a pyrethroid pesticide effective in plant pest control and has a very strong insecticide and gastrointestinal exposure with broad range treatment including insect pests on various crops, pests and worms of fruit trees, and in the greenhouse against ornamental plants and pests of sugar beet (6).

Since dursban and chlorpyrifos have long been recommended by plant experts of Isfahan sugar factory to sugar beet farmers, the major venom toxin, this study was aimed to assess the remaining amount of the two toxins in sugar roots that enter to the factory.

2. Methods and Materials

This study has been performed on sugar beets which were entered into Isfahan Sugar Company. In this study, five cities in Isfahan province in which sugar beet was harvested including the cities of Isfahan, Borkhar, Semirom, Fereidan and Golpayegan were involved.

2.1. Sampling

Following coordination with the company at 17 September 2010, a sample unit equal to 4500 grams from each truck that entered into the factory and eight repetitions of each city were picked up randomly. Some parts of the beet pieces weighing 200 grams in total were isolated and labeled and were placed inside a nylon.

2.2. Extraction

After transferring the samples to the laboratory, pieces of beet were divided into smaller sizes and became uniform with an electric mill. A small glass with a metal lid was put on a digital scale, then an amount of 50 g of homogenized sugar beets had been poured into the glass and about 150 ml of acetone were added to the contents inside the bottle and the mixture were kept at 4˚C.

Three weeks later the samples were taken out of the fridge and were extraction process was continued with proper filter. The pulp was removed and the extract was put into clean containers and then transferred to the refrigerator. In order to measure Dursban and Chlorpyrifos pesticide residues using the HPTLC method, the samples were placed on ice and were transported to the laboratory. The acetone in the mixture was evaporated at room temperature. The extract was mixed with the 150 ml of chloromethan inside along with 4% solution of sodium sulfate and then extraction operation was conducted. Then the extract was placed in the vicinity of 30 g sodium sulfate without water for 40 minute to remove impurities and turbidity. The resulting extract was dried by the evaporation device under vacuum. Columns containing silica gel were used for purification and color removal of the samples (8).

2.3. Measurement

Spots marking: spots markings were made on the pages of Silica gel 60F254) 20 × 20 cm, (Merck Co.) and five milliliter capillary tubes. In each silica gel, 15 spots including 3 standard spots and 12 unknown spots (a solution prepared from sugar beet samples) with a distance between 1 cm and 3 cm from the sides of each plate were placed. For the spots growth a mixture of hexane/ethyl acetate (90%/10%) for dursban poison were poured into chromatography tank for 30 min till the space inside reached saturation. the spotted sheets were put in the tank containing the solvent. To grow the spots and the ascending of the solvent up to the end of the fixed phase at 25˚C for 25 minutes was required. After the growth of mobile phase on the stationary phase, UV wavelength of 254 nm was used for the top spots. Plates were scanned using CAMAG absorption, scanner 3 (TLC Company, Switzerland) for dursban detection. Spots were detected using a deuterium lamp with a wavelength of 207 nm for dursban poison. CATS4 software was used for quantitative measurement of the dursban toxin grown in the spots.

3. Results and Discussion

The average amount of dursban pesticide residues in the studied regions is shown in Table 1. According to these results, the highest and lowest level of the remaining poison were observed in Borkhar and Isfahan-Golpayeghan, respectively.

Table1. Descriptive statistics (Mean ± SD) of dursban pesticide residues in sugar beet derived from different areas of Isfahan province

Areas	Borkhar	Isfahan	Semirom	Golpayegan	Frieden
Dursban mg / kg)	0.032±0.014	0.035±0.010	0.046±0.005	0.029±0.013	0.039±0.009

As shown in table2, mean comparison with the expected mean using one sample t-test showed that amount of dursban remained in all studied areas was significantly higher than the allowable level (10).

Table2. Mean comparison allowable pesticide dursban residues with its acceptable refrence (0. 01 mg /kg) in areas of Isfahan province

Area	Borkhar	Isfahan	Semirom	Golpayegan	Fereidan
P-value	0.009	<0.004	<0.08	<0.002	<0.011

Levene test was used to evaluate variance homogeneity of Dursban residue among mentioned areas. Since calculated P-value (<0.0001) indicate presence of variance heterogeneity among different areas. Mean comparisons among different areas was conducted following ANOVA procedure using Duncan multiple range test (table3). The Dursban residue in Golpayegan and Borkhar was significantly higher than other regions, while the least pesticide was observed in Isfahan and Fereidan.

Table 3. The amount of dursban toxin used in the different areas

Area	Borkhar	Isfahan	Semirom	Golpayegan	Fereidan
The amount of toxin consumed (L / Ha)	0.23	0.23	1.68	0.23	0.84

At present the major and the most practical method to struggle with pests and plant insect vector diseases in Iran and also most of non-developed countries is chemical confrontation. This method is superior to other methods because of its rapid-acting, though implementing this approach brings forth the incidence of difficulties especially important environmental problems (9). Dursban is a very strong poison with an occurrence period of 3 days and lasting around 23 days in soil (6). Given this and the time takes from the sugar beet harvest to the factory delivery, it can be concluded that the amount of toxin can reduce drastically in the product and as the results of this study showed the amount of remaining dursban toxin on the beet was very low.

Other researches in this field have been done on other crops in the world, including the remaining of the two insecticides dursban and permethrin on lettuce conducted in 1982 showed that if the normal dose of both insecticide were used in 5.12and 25 grams per hectare, the remained toxin in a few days before the harvest in lettuce is 1mg/kg. application of high doses of permethrin (up to 25 grams per hectare) two weeks before the harvest indicated that the remaining pesticide residue (0.2 mg / kg) for dursban toxin is considerably high (10).In another study, dursban pesticide residues were measured on wheat and potato in 2006 with the HPLC method. Results showed the presence of residues in both products was exceeded than their allowable limits (0.10ppm for wheat and 1.00ppm for potatoes) (11).The remaining toxins of pymetrozine, tetradifon, dursban on cucumber in Damavand area using gas chromatography, showed that tetradifon and pymetrozine were over the limit in some stations for two seasons of sampling (12).

As it is seen in some studies, this toxin is higher than the allowable limit in different farms of Iran. Perhaps to justify the difference it can be concluded that the time between harvesting and consumption has been so short which could resulted in higher levels of dursban beyond the acceptable limit. The use of dursban with a proper dose is less threatening for the consumer health. Also, giving instruction and awareness for pest control to farmers by executive agencies and proper consultations with sugar factories could reduce pesticide residue application and subsequently the amount of remaining toxin in mature sugar beet and their final by-products.

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